INTRA-UTERINE ANTIBIOTIC TREATMENT OF LOW FERTILITY DAIRY COWS

By

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INTRODUCTION

The success or failure of any dairyman is largely dependent upon the reproductive efficiency of his herd. Regardless of how proficient a dairyman he may be, economic returns cannot be satisfactory if the reproductive efficiency of the herd is unsatisfactory. Any factor which tends to lengthen the calving interval will also tend to reduce the economic returns of the herd involved. Some of the factors that may be responsible for lengthening the calving interval are: (a) pathogenic organisms; (b) non-pathogenic organisms; (c) persistent corpus luteum; (d) cystic ovaries; (e) anatomical defects; (f) nutritional deficiencies; (g) age of the animal and a host of other causes.

This experiment was conducted to observe any effects that the intra-uterine administration of antibiotics might have on the reproductive efficiency of the Oklahoma State University dairy herd. Vibriosis had been diagnosed in the herd in 1956, 1957 and 1958. The trial period included the thirteen months from February 1, 1957 to March 1, 1958.

In the analysis of the data from the experiment an attempt was made to study the effects of the antibiotics on two items in particular: (a) the number of services required per conception, and (b) the length of estrous cycles following infertile service.

REVIEW OF LITERATURE

Numerous investigators (1,5,6,7,8,13,16,17,24,26) have shown that the intra-uterine use of antibiotics was effective in overcoming Vibrio fetus infection. Other conditions such as pyometra and inflammation of the reproductive tract have also been overcome by the intra-uterine use of antibiotics.

Lofthouse (16) was associated with a herd which was known to be infected with Vibrio fetus. The disease was judged to be in an advanced state since only 9 of the 43 milking cows were with calf. All other cows were in the stage of repeat breeding. Each cow was observed to pass excessive discharge a few hours after service. A group of eight of these cows were administered a five day intra-uterine treatment. Treatment consisted of one million units of penicillin on the first day and 500,000 units of penicillin on each of the next four days. Each cow conceived at the next service and the discharge following service was not observed. Ten other cows in the same herd were then treated in the same way. Nine of these cows conceived at first service and one cow conceived at a second service.

Roberts (22) examined and treated 439 repeat breeding cows during a nine year period. All of these cows had been bred unsuccessfully two or more times since the last parturition and prior to treatment. The treatments used were intra-uterine injections of: (a) 200,000 units of penicillin and 200 mg. streptomycin in 20 ml. of a water-in-oil emulsion for one group of cows; (b) 500,000 to one million units of penicillin

and one gram of streptomycin in 20 to 40 ml. of sterile distilled water for a second group of cows; and (c) 500,000 to one million units of penicillin and one gram of streptomycin in 20 to 40 ml. of Merameth (a commercial preparation) for a third group of cows. The treatment solutions were administered into both uterine horns with the aid of a steel catheter. The conception rate for treatment "a" was 46.3% at first service and 60.0% for first and second services. Forty-four cows treated by methods "b" and "c" had a conception rate of 43.2% at first service and 65.9% for first and second services respectively.

Roberts also used 40 to 50 ml. of a 0.05% aqueous solution containing 2 mg. of tyrothricin per ml. This solution was injected into the uterus of one group of cows during estrus. The same treatment was administered to a second group of cows at some time during the period from the end of estrus to within three days of the next expected estrus. Both groups of cows were not bred until the second estrus following treatment. A total of 45 cows were treated by these procedures. Seventeen of these cows conceived at first service and six cows conceived at second service. Eighteen of the remaining 22 cows were later sold as sterile. Uterine biopsy and examination at the time of slaughter showed the tyrothricin treatment produced a severe inflammatory reaction in the endometrium. Tyrothricin yielded the poorest results of any antibiotic used.

Ulberg, et al. (25) conducted a trial involving 57 open cows that had been bred four or more times. Treatment consisted of the intrauterine infusion of 125 ml. of sterile distilled water containing 0.25 gram of intravenous grade aureomycin HCl, 1.0 gram of dihydrostreptomycin and 100,000 units of crystalline penicillin. Following the

infusion the uterus was massaged to obtain maximum contact of the antibiotics with the epithelium. Group I cows received this treatment 17 days after the beginning of estrum. Group II cows were administered the treatment at the first sign of estrus and were bred 12 hours later. All cows that did not return to estrus within 34 days were slaughtered and examined for pregnancy. Normal embryos were found in 28.6% of the cows in Group I as compared to 50.0% for the control group. Normal fetuses were found in 37.8% of the cows in Group II as compared to 57.9% for the control group. The authors suggested that the antibiotics were causing the deaths of the normal embryos in the treated groups. An earlier experiment involving 109 repeat breeding cows was reported. Treatment resulted in 24.8% normal pregnancies at 34 days as compared to 47.4% normal pregnancies in 19 untreated control cows.

Easterbrooks, et al. (8) reviewed work conducted at Connecticut in which different treatments were used. The simplest effective treatment for Vibrio fetus was found to be three months of sexual rest. The intra-uterine infusion of from 500 mg. to 1.0 gram of streptomycin in 20 to 30 ml. of sterile distilled water was at least as effective as other treatments. The use of chloromycetin, aureomycin, terramycin, Polyotic, streptomycin and streptomycin plus penicillin in concentrations of 500 mg. to 1.0 gram and suspended in 20 to 30 ml. of sterile distilled water was discussed. Streptomycin was found to have a higher solubility and a lower unit cost than the other compounds used and could be administered at any time during the estrous cycle without causing leukocytosis and other side effects as observed in conjunction with other types of treatment.

Easterbrooks and Plastridge (6) conducted an experiment with six repeat breeding cows from a herd known to be infected with Vibrio fetus. Three cows were used as controls and three cows were administered an intra-uterine infusion of 1.0 gram of streptomycin and 200,000 units of penicillin in 20 ml. of a commercial water-in-oil emulsion. The treated cows were not bred during the estrus at which treatment was administered but were bred at the next estrus. The treated cows all conceived at the first service following treatment while two of the three control cows conceived at their third service. The third control cow was slaughtered after failing to conceive at eight services.

Easterbrooks and Plastridge (5) were successful in controlling vibriosis with intra-uterine infusions of streptomycin, streptomycin plus penicillin, chloromycetin, terramycin and Polyotic. One-half to 1.0 gram of each of the above antibiotics was dispersed in 20 to 50 ml. of sterile distilled water or saline. They recommended that the cow be treated at one estrus and bred the next or that the cow be bred and treated a few hours later.

Easterbrooks and Plastridge (7) were successful in controlling Vibrio fetus in heifers with an intra-uterine infusion of 1.0 gram streptomycin in 20 ml. of sterile water. Treatment during any stage of the estrous cycle was found to be effective and safe. They also found that this treatment permitted aborting cows and heifers to return to reproductive normalcy more rapidly than was otherwise true.

Fincher (9) stated that increased sexual rest following parturition increased the chances for conception. He cited an Illinois study in which 1674 pregnancies in 593 cows were reported. The results indicated that fertility increased as the interval between parturition and first

service approached 100 to 120 days. Fincher obtained good results from the use of 1.0 to 2.0 grams of streptomycin and 200,000 to 500,000 units of penicillin in 20 to 100 ml. of saline when this solution was used as an intra-uterine infusion a few days prior to breeding. He obtained good results from the intra-uterine infusion of 40 to 100 ml. of tyrothricin, containing 0.3 mg. to 0.5 mg. of tyrothricin per ml., while the cow was in estrus. The cow was then bred at the next estrus. Fincher also recommended the use of penicillin and streptomycin in 20 to 100 ml. of a water-in-oil emulsion in controlling pyometra providing breeding was delayed for at least 10 days after treatment. The work of McAuliff was cited in which open cows were treated with 0.5 gram of streptomycin plus 400,000 units of penicillin suspended in a water-in-oil emulsion as soon as vibriosis was detected. Each cow was administered an additional treatment of 1.0 gram of streptomycin at the onset of the next estrus and was then bred six to eight hours later.

Haubrick (2,10,11) recommended an intra-uterine infusion of 2.0 grams of streptomycin in 50 ml. of sterile water at the second estrus following vibrionic abortion. The treatment for dairy heifers having vibriosis was 1.0 gram of streptomycin in 10 ml. of sterile water introduced into the uterus at the onset of estrus. It was recommended that the heifer be bred 8 to 10 hours after treatment. Haubrick also stated that an indurated cervix was common in infertile cows and heifers. This condition was treated with 100,000 to 200,000 units of penicillin in 2 to 5 ml. of sterile water and deposited in the mid-cervical area. This treatment was administered at the onset of estrus and the cow bred 8 to 10 hours later.

Herrick (12) reported work with 78 cows that had been bred three or more times without conceiving and which were showing estrous cycles of normal length. The uteri of these cows were found to be of normal size although they were often spongy and lacking in tone. There was no evidence of a discharge in most cows. All cows were administered an intra-uterine infusion at the onset of estrus of 1.0 gram of streptomycin and 400,000 units of penicillin in 25 ml. of a 3.0% sodium citrate solution. One-half of these cows were bred artificially and the others were bred naturally to a bull of known fertility. Conception at first service after treatment was 68.0%. Ten of the remaining cows remained open after repeated services and treatments. They were observed to discharge a pus-flaked exudate. Herrick concluded that these antibiotics were effective in controlling endometritis. He suggested that the citrate solution acted as a foreign agent in the uterus and thus increased the activity of the epithelial cells, thereby increasing the chances of survival for the fertilized ovum.

Easley, et al. (4) summarized the breeding records of 460 Hereford cows and found 80 repeat breeders in the group. The repeat breeders were divided into four groups. Group I cows were given 2 to 5 months sexual rest and then were rebred. Ten percent of these cows conceived at first service and 19% conceived at second service. Groups II, III and IV were administered intra-uterine infusions of 200,000 units of penicillin and/or 1.0 gram of an aureomycin ointment suspended in 50 ml. of Merameth solution. These compounds were used separately and in different combinations. Group II cows were given the same sexual rest as Group I with the exception that during one estrus of the rest period an infusion was administered. Conception at first and second service

for this group was 56.8%. Group III cows were administered the treatment at one estrus and were bred at the next estrus. Conception at first and second service for this group was 59.0%. Group IV cows were treated the day after breeding and conception at first and second services was 80.0%.

Chambers (3) treated five repeat breeding cows with an intra-uterine infusion of 100,000 to 500,000 units of penicillin in 10 to 15 ml. of sterile water. Each cow was bred at the next estrus and conceived at that time. In a later trial, Chambers used 200,000 units of penicillin in 15 ml. of sterile water. The results of this treatment were reported to be quite satisfactory. It was felt that cows that had retained placentas should be administered several such infusions to clear the severe metritis associated with placental retention. The thesis was advanced that lowered fertility could be expected to respond favorably to treatment if it was not associated with adhesions or neoplasms.

McEntee (17) recommended an intra-uterine treatment of 1.0 gram of streptomycin in sterile water for vibriosis. He suggested treatment on three successive days and stated that the stage of the estrous cycle at the time of infusion did not influence recovery. A second treatment, used on a group of 38 heifers, was 1.0 gram of streptomycin in sterile water infused into the uterus. This treatment was administered only twice at 48 hour intervals. These heifers were bred at the first estrus after treatment and 37 conceived at first service. The use of aureomycin and combinations of penicillin and streptomycin were not better than streptomycin alone.

Asdell (1) recommended the intra-uterine infusion of 1.0 gram of streptomycin in 15 ml. of sterile water at the third estrus following parturition for vibrionic cows and heifers. The treated cattle should then be bred at the next estrus. He recommended this treatment at the first estrus following a vibrionic abortion with breeding to follow at the next estrus if the cow appeared to be normal at that time.

Lindley (15) reported data on 190 cows that were treated in one of four ways after they had not conceived at two or more services. The 82 cows in Group I were administered an intra-uterine infusion of 1.0 gram of streptomycin and 200,000 to 500,000 units of penicillin in 50 ml. of saline. The treatment was administered on either the first or seond day following breeding. Sixty-five percent of these cows conceived at first service and 78% conceived at first or second services. Fifty-one Group II cows received the same treatment as did the cows in Group I except that the antibiotics were dispersed in 50 ml. of sterile water. Fifty-one percent of these cows conceived at the first service and 61% at the first or second service. The nine cows in Group III were administered the same antibiotics as were Groups I and II. In this case 50 ml. of a 12% sulfapyridine solution was used as the carrier. Seventy-eight percent of these cows conceived at the first service and 89% conceived at first or second service following treatment. The 48 cows in Group IV were not treated and served as a control group. Of these 33% conceived at first service. The data concerning conception to additional services were not presented.

Hintze (13) reported that vibrionic infection was effectively controlled with an intra-uterine infusion of 1.0 gram of streptomycin in 30 to 50 ml. of sterile water. Hintze also reported that

endometritis was effectively controlled by an intra-uterine infusion of 1.0 gram of streptomycin and 500,000 units of penicillin in 30 to 50 ml. of sterile water when administered one or more times between estruses. The administration of terramycin and aureomycin was found to be effective in controlling endometritis and pyometra.

Schwab (23) stated that the abnormal discharge associated with pyometra and metritis could be controlled by a uterine irrigation with one gallon or more of a 2.0% Lugol solution. The introduction into the uterus of 100,000 to 300,000 units of penicillin in 6 to 8 oz. of mineral oil was recommended at four to five day intervals until the symptoms disappeared.

Woelffer (26) recommended an intra-uterine infusion of 100,000 to 300,000 units of penicillin in 10 to 20 ml. of sterile water or a streptomycin treatment for the control of vibrionic and trichomonad infections.

Woelffer (28) treated 19 repeat breeding cows with 100 ml. of an aqueous solution of tyrothricin in each uterine horn. Thirteen cows, or 68%, conceived at the next service.

In another report, Woelffer (27) reported the successful use of Polyotic, terramycin, aureomycin, gammamycin and streptomycin in the treatment of infertility in dairy cattle. He stated that a second treatment before breeding was often worthwhile.

Tutt (24) reported work with a Vibrio fetus infected herd that was averaging 4.5 services per conception. Twelve of these cows were administered an intra-uterine infusion of 4.0 gram of streptomycin in 2 oz. of sterile water on the first day of treatment. Two grams of streptomycin in 2 oz. of sterile water were administered daily for the

next four days. The cows were bred at the next estrus and nine conceived at that service.

Roark (21) reported the intra-uterine treatment of differing amounts of certain antibiotics and sulfonamides on 14 repeat breeding cows. Thirteen of the cows conceived at the first service after treatment.

The intra-uterine infusion of 300,000 to 500,000 units of aqueous penicillin was 60% effective for Moore (19) as a treatment for repeat breeding cows. Similar results were obtained by Millar (18) when he used streptomycin as a treatment for infertility.

EXPERIMENTAL PROCEDURE

The cows used in this experiment were from the Oklahoma State University dairy herd. Vibrio fetus was demonstrated in the herd in 1956, 1957 and 1958 by the cervico-vaginal mucus tampon test, by the isolation and culture of the organism from the stomach contents of aborted feti and by culture of the organism from the semen of certain herd sires. The Ayrshires, Guernseys, Holsteins and Jerseys constituting the cows in milk on February 28, 1957 were divided into three groups. The Herd Improvement Registry sheets were used as the lists for assigning cows to their respective groups since each sheet listed the cows of a particular breed according to age. The first cow of each breed was assigned at random to one of the experimental groups, i.e. to Group III. The second cow on that HIR sheet then fell in Group I and this cycle was continued until all cows were assigned. As new cows of a particular breed were brought into the herd, they were added at the bottom of the original listing and assigned to a particular group according to the sequence already established.

Group I cows served as a control group and were not treated. They were handled according to the routine breeding and management practices established for the herd and in effect at that time.

Group II cows were to be administered one intra-uterine injection consisting of one gram of dihydrostreptomycin and one million units of procaine penicillin G suspended in approximately 15 ml. of double

distilled water. This treatment was administered within 24 hours of the time the cow was first found in estrus at each estrus exhibited between the times of parturition and first service (approximately 60 days postpartum). Cows in this group were not treated after breeding was initiated.

Group III cows were treated in the same manner as Group II cows with the exception that treatment was continued each estrus until conception occurred or until the experiment was terminated.

Streptomycin was selected as the antibiotic to be used in the attempt to control Vibrio fetus. Penicillin was included in the treatment to inhibit, insofar as possible, other undesirable organisms of the reproductive tract.

The above methods and times of treatment were used until June 1, 1957. At that time it was discovered that only 25% of the expected number of treatments had been administered to those cows of Group II and Group III. This was due to the fact that the cows were not being held for treatment prior to the time that they were held for breeding. For this reason it was established that each cow in Group II and Group III would be treated on the 30th and 50th day postpartum regardless of whether or not they were exhibiting estrus. Beyond this, the treatment pattern described above was not altered.

The cows were prepared for treatment in accordance with accepted sanitary procedures used in the artificial insemination of cows. The rectum was cleared of feces, and the vulva washed with a disinfectant and dried. Standard artificial breeding catheters were worked through the cervix by the recto-vaginal procedure for artificial insemination.

The solution containing the antibiotics was administered from a standard glass or plastic syringe. The uterus and uterine horns were then massaged to insure contact of the antibiotics and the uterine mucosa.

Prior to June 1, 1957 the solution was passed through the usual plastic catheter used in the practice of artifical insemination. After June 1, 1957 the solution was passed through stainless steel catheters approximately 3 mm. in diameter. It was necessary to use these at all times when treatment was not administered during estrus since the cervix was not dilated. The syringes were washed thoroughly, rinsed and sterilized in an autoclave. The plastic catheters were discarded after a single use. The stainless steel catheters were washed, rinsed and placed in a drying oven at 140° C for a period of 24 hours before being reused.

The antibiotics used in the course of this experiment were purchased from the Oklahoma Veterinary College and stored in a refrigerator at approximately 45° F until they were used.

All of the cows were examined by a veterinarian 30 days after the experiment was terminated to ascertain whether the cows were pregnant or open.

RESULTS AND DISCUSSION

A summary of the reproductive performance and treatments of the groups and breeds employed in this study is presented in Table 1. Group I had the lowest number of services per conception of the three groups. This difference appeared to have been due primarily to a higher conception rate in Group I of the Holstein breed as compared to the conception rate in Groups II and III of the same breed.

The services per conception did not vary noticeably within groups of the other breeds with the possible exception of Group II of the Jersey breed. Here again the high services per conception figure was due primarily to two cows which were bred a total of twelve times without either cow conceiving.

A total of 328 treatments was administered to Groups II and III during the course of the experiment. The conception rates for Groups II and III were 5.64 and 5.47 services per conception respectively. It is definitely not the opinion of the author that the treatments were responsible for the lowered conception rates in Groups II and III. As pointed out above, this difference was due primarily to a number of repeat breeding cows in Groups II and III. A total of 620 breedings were made during the course of the experiment resulting in 124 known conceptions. The breeding efficiency for all groups and breeds was quite low with an average of 5.00 services required for each conception. This compared to 2.98 services per conception for the same herd during

TABLE 1

Summary of Reproductive Performance and Treatments

by Groups and Breeds

Breed and Group	Breedings	Conceptions	Services per Conception	No. Treatments
GUERNSEY				
Group I	48	8	6.00	-
Group II	44	8	5.50	7
Group III	52	8	6.50	64
HOLSTEIN				
Group I	77	20	3.85	-
Group II	104	14	7.43	19
Group III	85	11	7.72	119
JERSEY				
Group I	27	8	3.37	-
Group II	21	4	5.25	13
Group III	26	7	3.71	42
AYRSHIRE				
Group I	51	13	3.92	-
Group II	51	13	3.92	17
Group III	34	10	3.40	47
TOTALS				
Group I	203	49	4.14	-
Group II	220	39	5.64	56
Group III	197	36	5.47	272
GRAND TOTAL	620	124	5.00	328

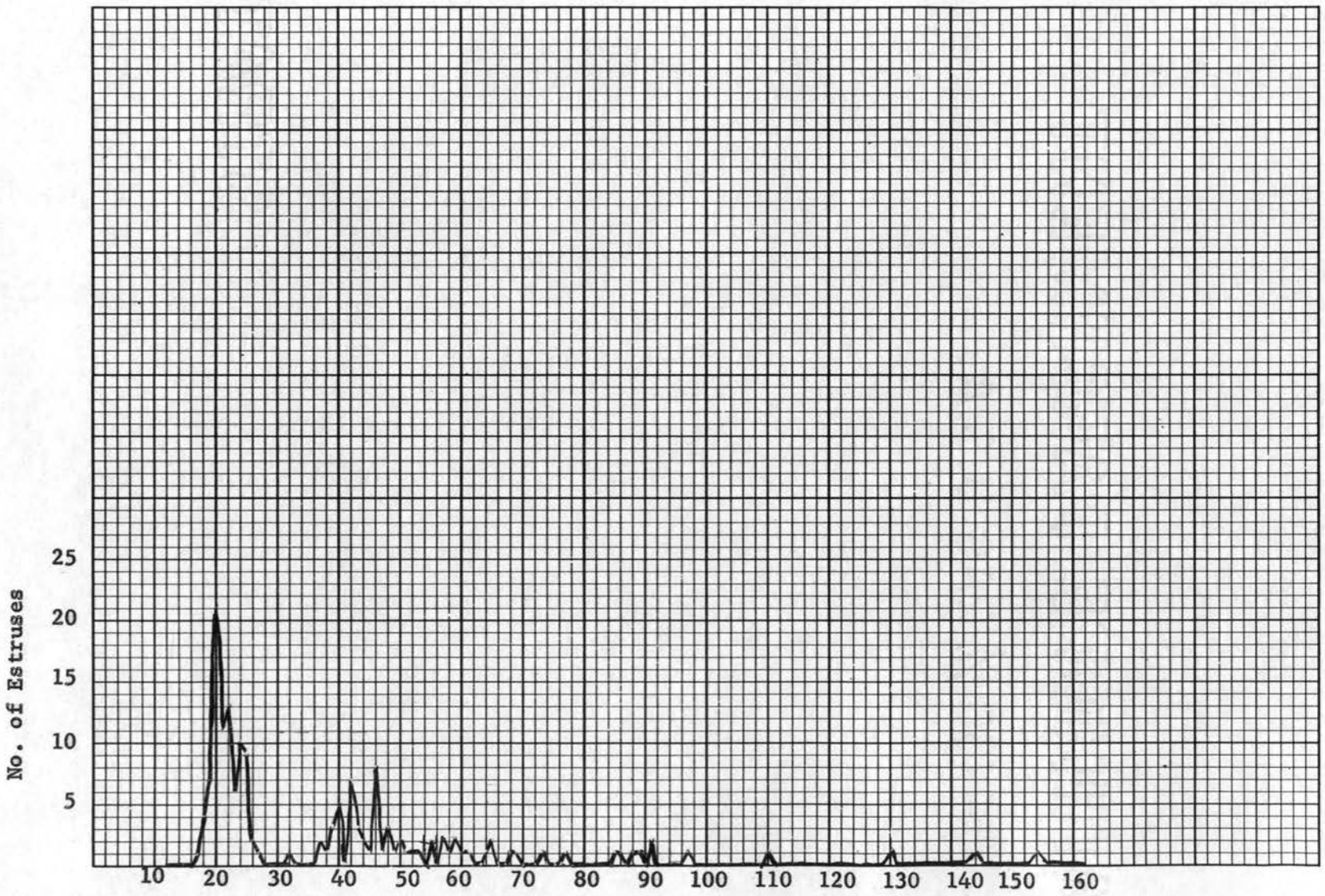

Figure 1. Frequency of Estrous Cycles Following Infertile Services - Group I

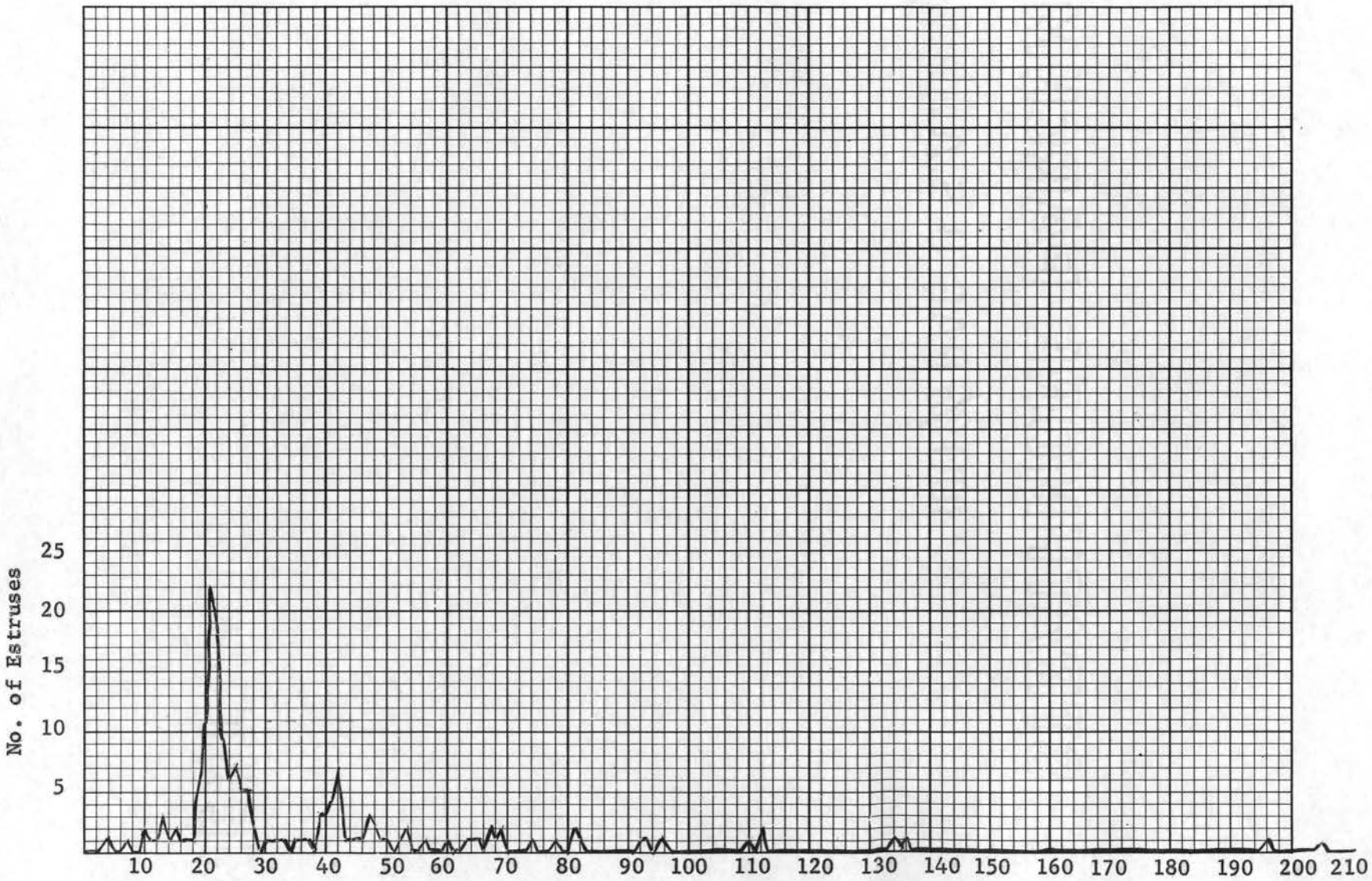

Figure 2. Frequency of Estrous Cycles Following Infertile Services- Group II

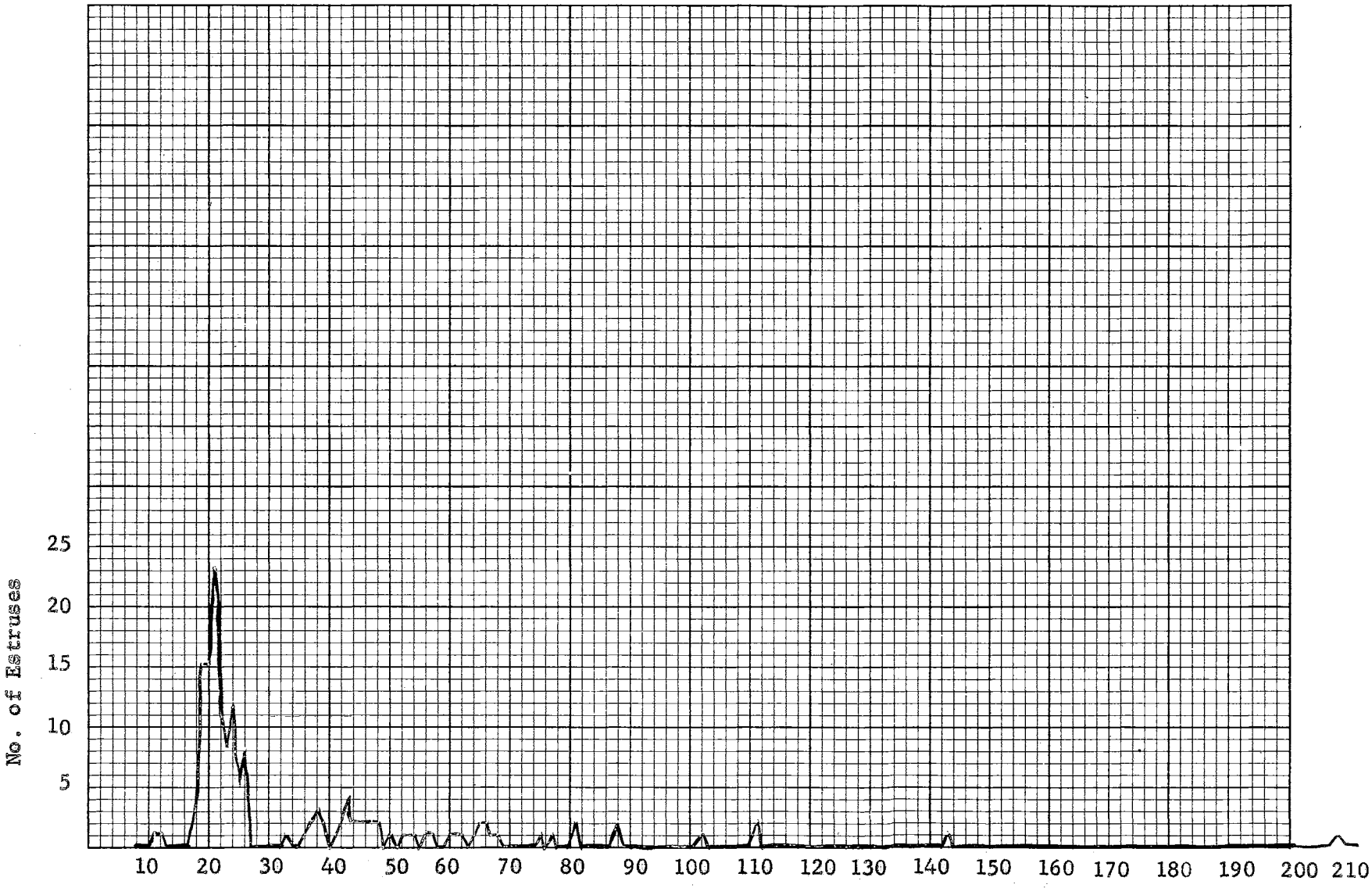

Figure 3. Frequency of Estrous Cycles Following Infertile Services - Group III

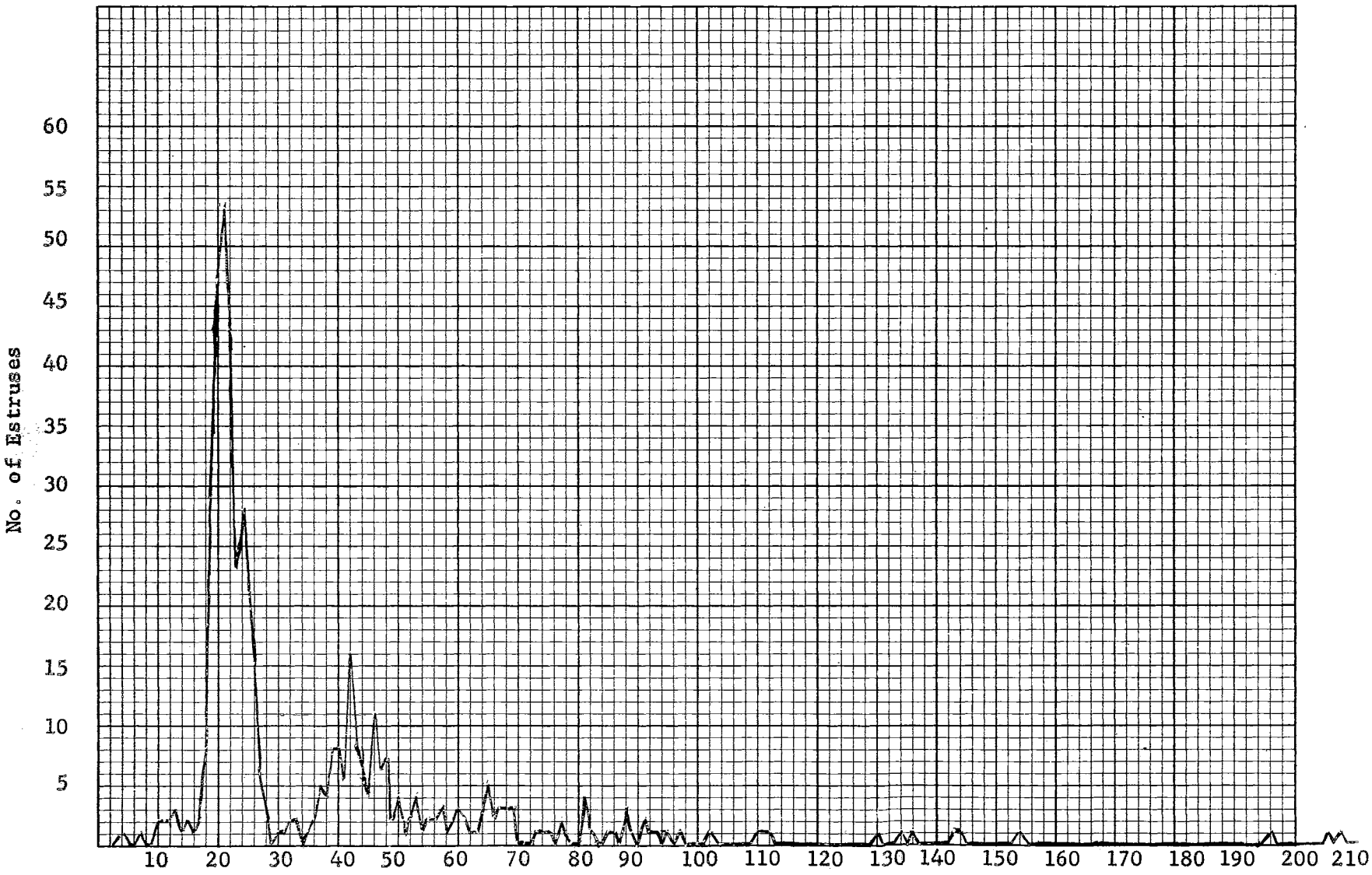

Figure 4. Frequency of Estrous Cycles Following Infertile Services - Total All Groups

a previous study period (15). Disease factors were undoubtedly partially responsible for the reduced fertility of the herd. As mentioned in the experimental procedure, vibriosis was positively diagnosed in the herd in 1956, 1957 and 1958.

Only two abortions were known to have occurred during the course of the experiment. Both of these occurred in Group II of the Holstein breed. There were six known cases of cystic ovaries; one each in Groups I and III and four in Group II.

A summary of the distribution of the herd in groups is presented in Table 2. A total of 52, 52 and 51 cows were allotted to Groups I, II and III respectively in the initial allotment. A total of 45 new cows entered the herd during the course of the experiment. The new cows which entered the herd were either first calf heifers or were new cows which were purchased. Group I received 15 of the new cows while Groups II and III received 14 and 13 respectively.

A total of 155 cows was in the herd at the beginning of the experiment. When the experiment was terminated 112 of the original cows remained in the herd. Forty of these cows were in Group I, while Groups II and III contained 35 and 37 cows respectively.

Forty-three cows were removed from the herd during the experimental period for various reasons such as sterility and death. These cows were uniformly distributed among the groups with Groups I, II and III losing 15, 14 and 14 cows respectively.

The reproductive records of 150 cows were utilized in this study. All cows that were not bred at least one time during the experiment were eliminated from the study before the results were tabulated. The number of cows in each group whose records were involved in this study were 55,

TABLE 2

Summary of Group Distribution

Group	No. of cows allotted per group at start of experiment	No. of original cows still in herd when experiment was terminated	No. of new cows entering herd during experimental period	No. of cows leaving herd for any reason	No. of cows in each group at close of trial (bred 1 time or more)
I	52	40	16	15	55
II	52	35	15	14	49
III	51	37	14	14	46
All Groups	155	112	45	43	150

TABLE 3

Distribution of Estruses Following Infertile Service

Estrus interval (days)	No. of estruses	% of total estruses
	Group I	
4- 17	1	.65
18- 24	72	46.45
25- 35	13	8.39
36- 48	36	23.22
49- 71	20	12.90
72- 95	8	5.16
96-207	5	3.23
Total	155	100.00

TABLE 3 (Continued)

Estrus interval (days)	No. of estruses	% of total estruses
	Group II	
4- 17	14	8.24
18- 24	75	44.12
25- 35	24	14.11
36- 48	27	15.88
49- 71	15	8.82
72- 95	8	4.71
96-207	7	4.12
Total	170	100.00
	Group III	
4- 17	2	1.30
18- 24	87	56.49
25- 35	14	9.09
36- 48	25	16.23
49- 71	15	9.74
72- 95	6	3.90
96-207	5	3.25
Total	154	100.00
	Total All Groups	
4- 17	17	3.55
18- 24	234	48.85
25- 35	51	10.65
36- 48	88	18.37
49- 71	50	10.44
72- 95	22	4.59
96-207	17	3.55
Total	479	100.00

49, and 46 for Groups I, II and III respectively. The reproductive records of the cows on which this study was based are presented in Table I. The cows are listed according to groups and according to breeds within groups.

The distribution of estruses following infertile service are presented in Table 3. Group III definitely had more estruses in the 18 to 24 day range than did Groups I or II. Group III had 87 out of 154 estruses or 56.4% within the 18 to 24 day range as compared to 72 out of 155 or 46.5% for Group I and 75 out of 170 or 44.1% for Group II. Group III also had a smaller percentage of estruses in the 72 to 95 and 96 to 207 day range than did Groups I and II. Group I had the smallest percentage of estruses in the 4 to 17 day range with Group III second. Group II had an unusually large number of estruses in this period when compared with Groups I and III. However, two cows were largely responsible for the short estrous cycles in Group II. One of the cows had five successive estrous cycles within the 4 to 17 day range immediately following an abortion. This cow appeared to be the only serious case of nymphomania in the herd.

The frequencies of estruses following infertile service are listed by length in days and by their occurrence between the different estrus periods in Table II. This same material is also presented graphically in Figures 1 through 4. From Figure 1 it can easily be seen that the most frequent length of the estrous cycle was 20 days for Group I. However, Figures 2 and 3 differ from Figure 1 in that the most frequent length of the estrous cycle was 21 days. It is possible that the treatments administered to Groups II and III were at least partially responsible for the higher incidence of the so-called normal

21 day estrous cycle in Groups II and III. This would indicate that probably the greatest factor in the return to estrus following service was that the egg was not fertilized, or if it was fertilized, the embryo did not survive long enough to effect a change in the hormonal balance of the cow. The hormonal balance is the mechanism responsible for bringing the cow back into estrus again at the normal time period. Other factors to be considered are semen of lowered fertility, ova of decreased viability and improper timing of service.

A second peak was observed in the 39 to 44 day range. This peak could have been due to two main causes: first, the cows could have returned to estrus but due to a silent or extremely short estrus they were overlooked; second, such conditions as persistent corpus luteum and disease factors undoubtedly affected the length of intervals between infertile estruses.

The average intervals between successive estrual periods following infertile services are presented in Table 4. The average length of intervals varied from 21.5 days to 55.8 days. There was no apparent increase or decrease in the average length of estrous cycle as the estrual interval number increased. The length of interval between the sixth and seventh estruses was unusually small for all three groups. This was believed to have been due to chance rather than an estrual, group or treatment effect.

The average interval between infertile estruses per group is presented in Table 5. Group I had the longest interval with an average of 37.99 days, while Groups II and III had intervals of 35.98 and 34.82 days respectively. It is the opinion of the author that the decrease in average length of estrual interval in Groups II and III was at least

TABLE 4

Average Time Interval Between Successive Estrual Periods Following Infertile Services

Group	Estrual Intervals								
	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9	9 & >
I	30.5 (35)*	36.9 (29)	38.0 (21)	53.3 (17)	41.9 (12)	24.8 (8)	39.0 (6)	36.8 (5)	39.4 (22)
II	39.1 (34)	35.9 (30)	32.6 (25)	42.4 (17)	55.8 (10)	24.9 (9)	27.0 (8)	21.5 (8)	29.7 (26)
III	37.8 (35)	32.7 (27)	46.2 (19)	37.5 (14)	28.9 (12)	24.3 (9)	49.8 (7)	31.6 (5)	25.3 (26)

*Figures in parentheses represent number of observations involved in average.

TABLE 5

Summary of Estrus Intervals Following Infertile Service

Group	No. of cows	Average No. infertile estruses/cow	Average days between infertile estruses	Total estruses	Total estimated days lost
I	59	3.44	37.99	203	7,711
II	55	4.00	35.98	220	7,916
III	53	3.71	34.82	197	6,847
All Groups	167	3.71	36.26	620	22,474

partially the result of the treatments administered those groups. Group I received no treatments while Groups II and III received 56 and 272 treatments respectively. Group II averaged 2.01 days less per estrual interval than Group I, while Group III averaged 3.17 days less than Group I and 1.16 days less than Group II. The average length between infertile estruses for all groups was 36.26 days. This figure is considerably smaller than the 41.66 day figure obtained in an earlier study on the same herd (14).

The average number of infertile estruses per cow is also presented in Table 5. It is evident here that the treatments administered to Groups II and III did not reduce the average number of infertile estruses per cow since Group I which received no treatment had the lowest number of infertile estruses per cow with 3.44. This compared with 4.00 and 3.71 for Groups II and III respectively.

Table 5 further emphasizes the tremendous amount of potential productive and reproductive time lost due to infertile services. This lost time is due primarily to two factors: first, the high number of services required per conception; and second, the unusual length of the estrual intervals following infertile services. The total of 22,474 days lost for all groups represents the loss of 73.68 305 day lactations over the thirteen month trial period. There was a decrease in the number of days lost in Group III when compared to Groups I and II even when adjustments were made for the smaller number of cows in Group III. It appears from these data that reduced breeding efficiency may be a far greater economic factor than has previously been recognized.

Table 6 presents the number of cows conceiving at service during each estrus. There were more cows conceiving at the first service than

at any other service. This was certainly to be expected since more cows received first service than any other service. The number of cows conceiving at estruses two through five were more uniform than would have been expected. There was little difference, if any, between groups. Therefore, it would appear that the administration of treatments in Groups II and III did not affect the chances of conceiving at any given estrus. Group I had the largest number of cows conceiving with a total of 49. Groups II and III were lower primarily because they contained more problem breeders that failed to conceive and were either sold open or were open when the trial was terminated. A second reason could be the fact that Groups II and III were somewhat smaller than Group I.

The services per conception by groups and by months are presented in Table 7. It would be difficult to make a definite statement concerning the services per conception by group per month. The services per conception were so erratic from month to month and from group to group that evaluation on a group basis would be difficult. However, there was a general trend toward reducing the services per conception by month as the experiment progressed when all groups were totaled together. It is the opinion of the author that the declining number of services per conception was due in part to the treatments administered. It is recognized that a small number of cows diagnosed as pregnant when the trial was terminated may return to heat and thus effect an increase in the services per conception for the last two or three months. The table indicates that the maximum breeding efficiency was obtained in the late summer or early fall.

The numbers of estrual cycles 25 days and over for each estrus interval are presented in Table 8. It is the considered opinion of the author that the greatest single effect of the treatments administered to

TABLE 6

Number of Cows Conceiving to each Estrus - by Group

Group	Estrus number 1st	2nd	3rd	4th	5th	6th	7th	8th	9th & >	Total
I	12	6	8	6	4	5	3	1	4	49
II	13	3	7	5	4	2	-	-	5	39
III	7	6	6	5	4	1	1	2	4	36

TABLE 7

Services per Conception by Groups and by Months

Month	Group I No. Sv.	No. Conc.	Sv. /c	Group II No. Sv.	No. Conc.	Sv. /c	Group III No. Sv.	No. Conc.	Sv. /c	Total No. Sv.	No. Conc.	Sv. /c
Feb.	11	2	5.5	14	1	14.0	17	0	--	42	3	14.0
Mar.	18	1	18.0	16	2	8.0	17	3	5.7	51	6	8.5
Apr.	22	1	22.0	18	3	6.0	20	4	5.0	60	8	7.5
May	24	6	4.0	17	3	5.7	15	3	5.0	56	12	4.7
June	17	2	8.5	10	1	10.0	16	3	5.3	43	6	7.2
July	11	1	11.0	10	1	10.0	7	1	7.0	28	3	9.3
Aug.	20	7	2.9	18	2	9.0	11	5	2.0	49	12	4.1
Sept.	7	3	2.3	15	5	3.0	11	2	5.5	33	10	3.3
Oct.	19	10	2.0	21	7	3.0	16	3	5.3	56	20	4.1
Nov.	17	4	4.3	20	1	20.0	17	2	8.5	54	7	7.7
Dec.	19	1	19.0	26	5	5.0	20	5	4.0	65	16	4.1
Jan.	19	9	2.1	21	4	5.3	19	1	19.0	59	14	4.2
Feb.	11	2	5.5	15	7	2.1	13	2	6.5	39	11	3.5

Groups II and III can be seen in this table. The number of abnormally long estrous cycles was 83, 83 and 65 for Groups I, II and III respectively. It is assumed that the large number of treatments administered to Group III was at least partially responsible for the decrease in the number of abnormally long estrous cycles in that group. There are possibly two ways by which the treatments reduced the number of abnormal estrous cycles: first, by preventing the early death of the embryo; and second, by preventing the growth of pathological and non-pathological organisms in the reproductive tract of the treated cows. Infectious organisms in the reproductive tract can affect the length of the estrous cycle by causing an inflammation in the uterus which would kill the sperm or ova. The inflammation may also act to prevent the proper implantation of the fertilized ova. The number of cows with abnormal estrous cycles was lower in the two treated groups than in the control group with Group I containing 40 cows with abnormally long estrous cycles, while Groups II and III contained only 32 such cows each.

On the basis of the data obtained, it is felt that the methods of treatment used were not sufficiently effective to recommend their widespread adoption.

TABLE 8

Number of Estrous Cycles 25 Days and Over

for Each Estrus Interval

	Estrual Intervals									
Group	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9& >	Total
I	14	20	12	10	7	2	4	3	11	83
II	19	13	11	11	6	2	4	2	14	83
III	18	11	11	7	4	2	5	2	5	65
Totals	51	44	34	28	17	6	13	7	30	231

SUMMARY

This experiment was conducted to evaluate the effectiveness of streptomycin and penicillin in controlling Vibrio fetus and other organisms in the reproductive tract of dairy cows and heifers.

The Oklahoma State University dairy herd was divided into three equal groups for this purpose. Group I cows were designated as the control group and were not treated. Group II cows were administered one intra-uterine injection of 1.0 gram streptomycin and 1,000,000 units of penicillin at each estrus following parturition and until breeding was begun, or at 30 and 50 days postpartum. Group III cows were treated in the same way as Group II except that treatment was continued at each estrus until conception occurred or until the experiment was terminated. The carrier solution for the antibiotics was 15 ml. of double distilled water in all cases.

The number of services required per conception was 4.14, 5.64 and 5.47 for Groups I, II and III respectively and averaged 5.00 services per conception for all groups. The average length of estrous cycles following infertile service was 37.99, 35.98 and 34.82 days for Groups I, II and III respectively. The average for all groups was 36.26 days.

A total of 22,474 reproductive days were lost, during the thirteen month period covered by this experiment, due to the lowered reproductive efficiency of the herd.

Group II had the highest number of estruses with 220 as compared with 203 and 197 for Groups I and III respectively. Group II also had the lowest conception rate of the three groups. This is believed to have been due primarily to the characteristics of the repeat breeders in that group.

The number of estrous cycles 25 days and over was considerably smaller for Group III than for Groups I and II. The number of estruses occurring within the normal range of 18 to 24 days was also higher for Group III. It is the opinion of the author that the lower number of abnormally long estruses in Group III was due to the disease inhibiting effect of the antibiotics administered that group.

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A P P E N D I X

APPENDIX

TABLES PAGE

TABLE I

INTERVALS BETWEEN ESTRUAL PERIODS FOLLOWING INFERTILE SERVICES, BY GROUP AND BY BREED

Breed and Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
GROUP I															
GUERNSEY															
Maggie	20	21	23	24	46	27									
Early			25	144	65										
Eager				19	53	19	37	24	22	46					
Nifty							18	17	18	22	19	18	91		
Whisper	≠														
Julianna	42	22													
Unita						22	44	50	24	46	21				
Amb. Whisper						43	20	68	130	25	22	20	46		
Mazie									20	23	46	45	91		
Shirley	≠														
HOLSTEIN															
Varga				154*											
Polkadot	21	26	22												
Honesty					20										
Honesty	≠														
Countess	22	58	23	24	57										
Ina	24	69	22	65	23	22									
Korea	21	42	86												
Holiday	46	48	21	85											

≠ Conceived to first service
* Known cystic ovary

Table I (Continued)

Breed and Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
HOLSTEIN (continued)															
Lauxmaster												25			
Sweetness	20	18	20	55											
Alluring	57	48													
Betty	20	20													
Pride	⚡														
Klip	19	19	20	25											
Veneer	21	43	40												
Sussex	19														
Kove		20	39	40	38										
Koller	20	20	42												
Kleer	89	43	52	22	21	21									
Mandy	⚡														
Karoline	26	48													
Priscilla	24														
Konstance	42														
Foremost	⚡														
JERSEY															
Marcia	⚡														
Marbella	22	46	24	42											
Pagent	25	49	110												
Quick	42	20													
Qualified	39	40	50												
Nancy	⚡														

⚡Conceived to first service

Table I (Continued)

Breed and Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
JERSEY (continued)															
Elnor	25														
Maple	20	39	19	20	20										
Margie	21														
AYRSHIRE															
Burke						24	51	25	47						
Faultless	23	97	55	32											
Gaiety	25	25	24	73	77										
Kitten	59														
Russett	⚡														
Rilma	⚡														
Prim	61	40													
Starglow					37										
Starglow	24	20	21	22											
Karey	20	40	59	60	46	20	64								
Kara	22	20													
Berlin	⚡														
Berlin	-														
Belle	21	88													
Kit	23														
Caroline	-														
Chariot	⚡														
Faithworthy	44	42													

⚡ Conceived to first service
- Failed to conceive to first service

Table I (Continued)

Breed and Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
							GROUP II								
GUERNSEY															
Rarebit	42	20	19	134											
Honey						22	21	22	22						
Earring									21	23	22	23			
Julep	20	26	42	81											
Honeydew	21	112	21												
Edna	19	20	21												
Willie	48														
Wistaria	39	47	21	13	40	13	26	4	32	42	27	27	25		
Summons	26														
HOLSTEIN															
Koval			20												
Konawa											112**				
Pristina	16	16	25	27	92	22	26	30	33*						
Klimer	69	24	22	24	24	52	53	39	7	53					
Ruby	⌿														
Varuna	110	95	24	24	35	22	21	20	19						
Korona			40	21	205**	21	28	14	15	11	11	12	10		
Kola	⌿														
Hatpin	50	10	21	27											

⌿ Conceived to first service
* Known cystic ovary
**Known abortion

Table I (Continued)

Breed and Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services														
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
HOLSTEIN (continued)															
Koed	22	42	43	74	23	22	20	21*							
Carolyn							21	22	23	44	20	21	65	67	21*
Rose	69	68													
Kleen	ϟ														
Kliming	ϟ														
Hollyhock	41	22													
Success	136	23	25												
Harriett	36	81	48	25											
Castle	21														
Castle	ϟ														
Anita	22	25	49	25	25	28									
Klang	41	42	21												
Ione	13	47													
Carrie	ϟ														
JERSEY															
Normandy	ϟ														
Sp. Destiny	22	22	20	22											
Nada	47	23													
Marigold	19	19													
Fawn	21														
Fontain	22	23	93	78	23	22									

ϟ Conceived to first service
* Known cystic ovary

Table I (Continued)

Breed and Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services														
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
AYRSHIRE															
Geraldene	21	23	40												
Princess	≠														
Jolene													31	42	196
Joyce	22	23	31	39											
Charitable	42	20													
Klipper	≠														
Fable	46	19													
Charm	41	18	60	20											
Kildeer	20	82*													
Florence	21	27	19	45	67										
Dixie	-														
Charolette	64	21	63												
Janet	≠														
Kin	≠														
Rubella	≠														
Netty	56														
Fallacy	-														
Kathy	26	37	15	41	24										
							GROUP III								
GUERNSEY															
Ann					20	20	20	20	20	19	18	21	42	43	20

16-17	17-18	18-19	19-20	20-21	21-22
22	24	19	21	23	21*

≠Conceived to first service
-Failed to conceive to first service
*Known cystic ovary

Table I (Continued)

Breed and Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services														
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
GUERNSEY (continued)															
Raven				26											
Earmark	22	22													
Essential					21										
Joy	21														
Sherbert												24	22	22	24
Folly	18	39	64	19	45	24	19	38							
Curious					21	38	19	81	60						
Mab						21	21	48							
Jewel	44														
Wilhelmina	20	22													
Favorite	47														
HOLSTEIN															
Harmony	43	22													
Hester			11	20	19	23									
Arleta									23	38	22	18	21	21	
Annabelle	77	24	22												
Kolor	25	25	65												
Pinup	39	21													
Koronet	88														
Kling	37	23	21												
Palm	-														
Formosa	20	21	25	19	21	12	102	19	44	47	19				

-Failed to conceive to first service

Table I (Continued)

Breed and Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
HOLSTEIN (continued)															
Alma	65	88	24	36	23	54	53	21							
Konnie	26	23	22												
Pink	62	20	43	26	50	25									
Allie	20	25													
Form	46														
Polka	⁄														
Kollette		26	207	75	23										
Helen		111	21	111											
Annamae	19	43													
Honoria	33	26													
Holly	24	46													
JERSEY															
Erma	24														
Pandora	-														
Quantity	⁄														
Lavender	21	20	66	20	42	21	26								
Kate	⁄														
Kate	-														
Nora	26	23	48	26	24										
Quicksilver	⁄														
Nice	24														
Margie	19	45	57												

⁄Conceived to first service
-Failed to conceive to first service

Table I (Continued)

Breed and Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
AYRSHIRE															
Charity	✓														
Claudia	67	68	24	66											
Nerium	20	21													
Secret	21														
Diadem	24														
Flora	37	19	21	19											
Ruby	143														
Rural	61	19	81	41											
Chart	21	20	22												
Sally	19	21	56												
Charmer	✓														

✓Conceived to first service

TABLE II

LENGTH OF ESTRUSES FOLLOWING INFERTILE SERVICE

Days in Length	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9 & >	No. of Estruses Total
					GROUP I					
17	-	-	-	-	-	-	-	1	-	1
18	-	1	-	-	-	-	1	-	2	4
19	2	1	1	1	-	1	-	-	1	7
20	6	6	2	1	2	1	1	-	2	21
21	5	1	2	-	1	1	-	-	1	11
22	3	1	2	2	-	2	-	-	3	13
23	2	-	2	-	1	-	-	-	1	6
24	3	-	2	2	-	1	-	1	1	10
25	3	1	1	1	-	-	-	1	2	9
26	1	1	-	-	-	-	-	-	-	2
27	-	-	-	-	-	1	-	-	-	1
32	-	-	-	1	-	-	-	-	-	1
37	-	-	-	-	1	-	1	-	-	2
38	-	-	-	-	1	-	-	-	-	1
39	1	1	1	-	-	-	-	-	-	3
40	-	3	1	1	-	-	-	-	-	5
42	3	2	1	1	-	-	-	-	-	7
43	-	2	-	-	-	1	-	-	-	3
44	1	-	-	-	-	-	1	-	-	2
45	-	-	-	-	-	-	-	-	1	1
46	1	1	-	-	2	-	-	-	4	8
47	-	-	-	-	-	-	-	-	1	1
48	-	3	-	-	-	-	-	-	-	3
49	-	1	-	-	-	-	-	-	-	1
50	-	-	1	-	-	-	-	1	-	2
51	-	-	-	-	-	-	1	-	-	1
52	-	-	1	-	-	-	-	-	-	1
53	-	-	-	-	1	-	-	-	-	1
55	-	-	1	1	-	-	-	-	-	2
57	1	-	-	-	1	-	-	-	-	2
58	-	1	-	-	-	-	-	-	-	1
59	1	-	1	-	-	-	-	-	-	2
60	-	-	-	1	-	-	-	-	-	1
61	1	-	-	-	-	-	-	-	-	1
64	-	-	-	-	-	-	1	-	-	1
65	-	-	-	1	1	-	-	-	-	2
68	-	-	-	-	-	-	-	1	-	1
69	-	1	-	-	-	-	-	-	-	1
73	-	-	-	1	-	-	-	-	-	1
77	-	-	-	-	1	-	-	-	-	1
85	-	-	-	1	-	-	-	-	-	1

Table II (Continued)

Days in Length	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9 & >	No. of Estruses Total
86	-	-	1	-	-	-	-	-	-	1
88	-	1	-	-	-	-	-	-	-	1
89	1	-	-	-	-	-	-	-	-	1
91	-	-	-	-	-	-	-	-	2	2
97	-	-	1	-	-	-	-	-	-	1
110	-	-	1	-	-	-	-	-	-	1
130	-	-	-	-	-	-	-	-	1	1
144	-	-	-	1	-	-	-	-	-	1
154	-	-	-	1	-	-	-	-	-	1
					GROUP II					
4	-	-	-	-	-	-	-	1	-	1
7	-	-	-	-	-	-	-	-	1	1
10	-	1	-	-	-	-	-	-	1	2
11	-	-	-	-	-	-	-	-	1	1
12	-	-	-	-	-	-	-	-	1	1
13	1	-	-	1	-	1	-	-	-	3
14	-	-	-	-	-	-	-	1	-	1
15	-	-	1	-	-	-	-	-	1	2
16	1	-	-	-	-	-	-	-	-	1
17	-	1	-	-	-	-	-	-	-	1
18	-	1	-	-	-	-	-	-	-	1
19	2	2	2	-	-	-	-	-	1	7
20	1	4	2	1	-	1	1	1	1	12
21	4	1	7	1	-	2	3	1	3	22
22	5	3	1	1	-	4	-	2	2	18
23	-	4	-	-	2	-	-	-	3	9
24	-	1	1	2	2	-	-	-	-	6
25	-	1	2	2	1	-	-	-	1	7
26	2	1	-	-	-	-	2	-	-	5
27	-	1	-	2	-	-	-	-	2	5
28	-	-	-	-	-	1	1	-	-	2
30	-	-	-	-	-	-	-	1	-	1
31	-	-	-	-	-	-	-	-	1	1
32	-	-	-	-	-	-	-	-	1	1
33	-	-	-	-	-	-	-	-	1	1
35	-	-	-	-	1	-	-	-	-	1
36	1	-	-	-	-	-	-	-	-	1
37	-	1	-	-	-	-	-	-	-	1
39	1	-	-	1	-	-	-	1	-	3
40	-	-	2	-	1	-	-	-	-	3
41	3	-	-	1	-	-	-	-	-	4
42	2	2	1	-	-	-	-	-	2	7
43	-	-	1	-	-	-	-	-	-	1

Table II (Continued)

Days in Length	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9 & >	No. of Estruses Total
44	-	-	-	-	-	-	-	-	1	1
45	-	-	-	1	-	-	-	-	-	1
46	1	-	-	-	-	-	-	-	-	1
47	1	2	-	-	-	-	-	-	-	3
48	1	-	1	-	-	-	-	-	-	2
49	-	-	1	-	-	-	-	-	-	1
50	1	-	-	-	-	-	-	-	-	1
52	-	-	-	-	-	1	-	-	-	1
53	-	-	-	-	-	-	1	-	1	2
56	1	-	-	-	-	-	-	-	-	1
60	-	-	1	-	-	-	-	-	-	1
63	-	-	1	-	-	-	-	-	-	1
64	1	-	-	-	-	-	-	-	-	1
65	-	-	-	-	-	-	-	-	1	1
67	-	-	-	-	1	-	-	-	1	2
68	-	1	-	-	-	-	-	-	-	1
69	2	-	-	-	-	-	-	-	-	2
74	-	-	-	1	-	-	-	-	-	1
78	-	-	-	1	-	-	-	-	-	1
81	-	1	1	-	-	-	-	-	-	2
82	-	-	1	-	-	-	-	-	-	1
92	-	-	-	-	1	-	-	-	-	1
93	-	-	1	-	-	-	-	-	-	1
95	-	1	-	-	-	-	-	-	-	1
110	1	-	-	-	-	-	-	-	-	1
112	-	1	-	-	-	-	-	-	1	2
134	-	-	1	-	-	-	-	-	-	1
136	1	-	-	-	-	-	-	-	-	1
196	-	-	-	-	-	-	-	-	1	1
205	-	-	-	-	1	-	-	-	-	1
					GROUP III					
11	-	-	1	-	-	-	-	-	-	1
12	-	-	-	-	-	1	-	-	-	1
18	1	-	-	-	-	-	-	-	2	3
19	3	2	-	3	1	1	1	1	3	15
20	4	3	-	2	1	1	1	1	1	14
21	4	4	3	1	3	2	-	1	5	23
22	1	3	3	-	-	-	-	-	4	11
23	-	3	-	-	2	1	-	-	2	7
24	4	1	2	-	1	1	-	-	3	12
25	1	2	1	-	-	1	-	-	-	5
26	2	2	-	3	-	-	1	-	-	8
33	1	-	-	-	-	-	-	-	-	1

Table II (Continued)

Days in Length	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9 & >	No. of Estruses Total
36	-	-	-	1	-	-	-	-	-	1
37	2	-	-	-	-	-	-	-	-	2
38	-	-	-	-	1	-	-	1	1	3
39	1	1	-	-	-	-	-	-	-	2
41	-	-	-	1	-	-	-	-	-	1
42	-	-	-	-	1	-	-	-	1	2
43	1	1	1	-	-	-	-	-	1	4
44	1	-	-	-	-	-	-	-	1	2
45	-	1	-	-	1	-	-	-	-	2
46	1	1	-	-	-	-	-	-	-	2
47	1	-	-	-	-	-	-	-	1	2
48	-	-	1	-	-	1	-	-	-	2
50	-	-	-	-	1	-	-	-	-	1
53	-	-	-	-	-	1	-	-	-	1
54	-	-	-	-	-	1	-	-	-	1
56	-	-	1	-	-	-	-	-	-	1
57	-	-	1	-	-	-	-	-	-	1
60	-	-	-	-	-	-	-	1	-	1
61	1	-	-	-	-	-	-	-	-	1
62	1	-	-	-	-	-	-	-	-	1
64	-	-	1	-	-	-	-	-	-	1
65	1	-	1	-	-	-	-	-	-	2
66	-	-	1	1	-	-	-	-	-	2
67	1	-	-	-	-	-	-	-	-	1
68	-	1	-	-	-	-	-	-	-	1
75	-	-	-	1	-	-	-	-	-	1
77	1	-	-	-	-	-	-	-	-	1
81	-	-	1	-	-	1	-	-	-	2
88	1	1	-	-	-	-	-	-	-	2
102	-	-	-	-	-	-	1	-	-	1
111	-	1	-	1	-	-	-	-	-	2
143	1	-	-	-	-	-	-	-	-	1
207	-	-	1	-	-	-	-	-	-	1
					TOTAL ALL GROUPS					
4	-	-	-	-	-	-	-	1	-	1
7	-	-	-	-	-	-	-	-	1	1
10	-	1	-	-	-	-	-	-	1	2
11	-	-	1	-	-	-	-	-	1	2
12	-	-	-	-	-	1	-	-	1	2
13	1	-	-	1	-	1	-	-	-	3
14	-	-	-	-	-	-	-	1	-	1
15	-	-	1	-	-	-	-	-	1	2
16	1	-	-	-	-	-	-	-	-	1

Table II (Continued)

Days in Length	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9& >	No. of Estruses Total
17	-	1	-	-	-	-	-	1	-	2
18	1	2	-	-	-	-	1	-	4	8
19	7	5	3	3	1	2	1	1	5	29
20	11	13	4	4	3	3	3	2	4	47
21	13	6	12	2	4	5	3	2	9	56
22	9	7	6	3	-	6	-	2	9	42
23	2	7	2	-	5	1	-	-	6	23
24	7	2	5	4	3	2	-	1	4	28
25	4	4	4	3	1	1	-	1	3	21
26	5	4	-	3	-	-	3	-	-	15
27	-	1	-	2	-	1	-	-	2	6
28	-	-	-	-	-	1	1	-	-	2
30	-	-	-	-	-	-	-	1	-	1
31	-	-	-	-	-	-	-	-	1	1
32	-	-	-	1	-	-	-	-	1	2
33	1	-	-	-	-	-	-	-	1	2
35	-	-	-	-	1	-	-	-	-	1
36	1	-	-	1	-	-	-	-	-	2
37	2	1	-	-	1	-	1	-	-	5
38	-	-	-	-	2	-	-	1	1	4
39	3	2	1	1	-	-	-	1	-	8
40	-	3	3	1	1	-	-	-	-	8
41	3	-	-	2	-	-	-	-	-	5
42	5	4	2	1	1	-	-	-	3	16
43	1	3	2	-	-	1	-	-	1	8
44	2	-	-	-	-	-	1	-	2	5
45	-	1	-	1	1	-	-	-	1	4
46	3	2	-	-	-	2	-	-	4	11
47	2	2	-	-	-	-	-	-	2	6
48	1	3	2	-	-	1	-	-	-	7
49	-	1	1	-	-	-	-	-	-	2
50	1	-	1	-	1	-	-	1	-	4
51	-	-	-	-	-	-	1	-	-	1
52	-	-	1	-	-	1	-	-	-	2
53	-	-	-	-	1	1	1	-	1	4
54	-	-	-	-	-	1	-	-	-	1
55	-	-	1	1	-	-	-	-	-	2
56	1	-	1	-	-	-	-	-	-	2
57	1	-	1	-	1	-	-	-	-	3
58	-	1	-	-	-	-	-	-	-	1
59	1	-	1	-	-	-	-	-	-	2
60	-	-	1	1	-	-	-	1	-	3
61	2	-	-	-	-	-	-	-	-	2
62	1	-	-	-	-	-	-	-	-	1
63	-	-	1	-	-	-	-	-	-	1

Table II (Continued)

Days in Length	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9 & 7	No. of Estruses Total
64	1	-	1	-	-	-	1	-	-	3
65	1	-	1	1	1	-	-	-	1	5
66	-	-	1	1	-	-	-	-	-	2
67	1	-	-	-	1	-	-	-	1	3
68	-	2	-	-	-	-	-	1	-	3
69	2	1	-	-	-	-	-	-	-	3
73	-	-	-	1	-	-	-	-	-	1
74	-	-	-	1	-	-	-	-	-	1
75	-	-	-	1	-	-	-	-	-	1
77	1	-	-	-	1	-	-	-	-	2
78	-	-	-	1	-	-	-	-	-	1
81	-	1	2	-	-	1	-	-	-	4
82	-	-	1	-	-	-	-	-	-	1
85	-	-	-	1	-	-	-	-	-	1
86	-	-	1	-	-	-	-	-	-	1
88	1	2	-	-	-	-	-	-	-	3
89	1	-	-	-	-	-	-	-	-	1
91	-	-	-	-	-	-	-	-	2	2
92	-	-	-	-	1	-	-	-	-	1
93	-	-	1	-	-	-	-	-	-	1
95	-	1	-	-	-	-	-	-	-	1
97	-	-	1	-	-	-	-	-	-	1
102	-	-	-	-	-	-	1	-	-	1
110	1	-	1	-	-	-	-	-	-	2
111	-	1	-	1	-	-	-	-	-	2
112	-	1	-	-	-	-	-	-	1	2
130	-	-	-	-	-	-	-	-	1	1
134	-	-	1	-	-	-	-	-	-	1
136	1	-	-	-	-	-	-	-	-	1
143	1	-	-	-	-	-	-	-	-	1
144	-	-	-	1	-	-	-	-	-	1
154	-	-	-	1	-	-	-	-	-	1
196	-	-	-	-	-	-	-	-	1	1
205	-	-	-	-	1	-	-	-	-	1
207	-	-	1	-	-	-	-	-	-	1

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